THE PROGRESSIVE FISH CULTURIST

NEWS AND VIEWS FROM MANY SOURCES ON PRACTICAL HATCHERY PROBLEMS

ISSUED BY THE

BUREAU OF FISHERIES, U. S. DEPARTMENT OF COMMERCE

JULY 1937

WASHINGTON

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BUREAU OF FISHERIES U. S. DEPARTMENT OF COMMERCE

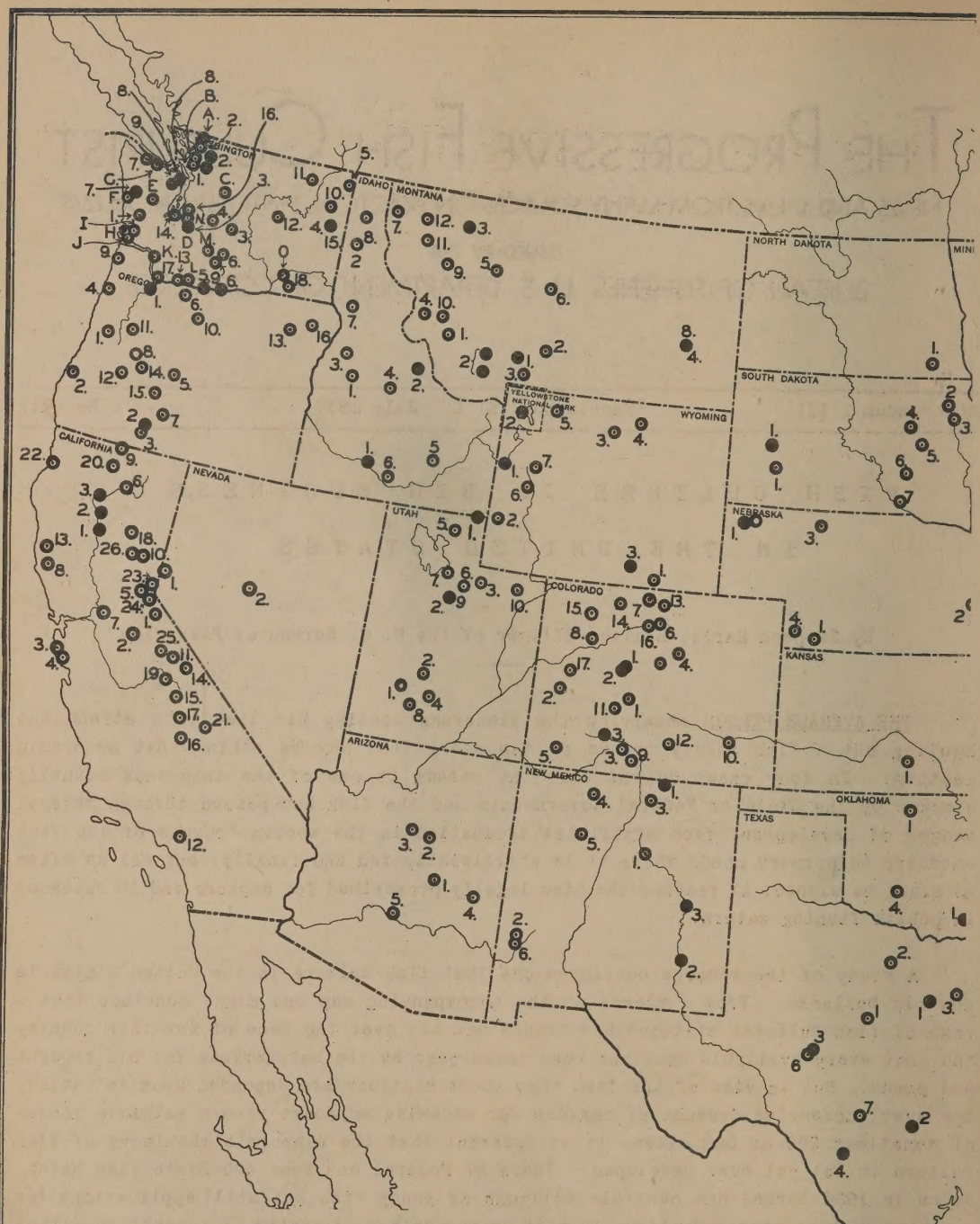
Memorandum I-131 Washington, D. C., July 1937 No. 31.

FISH CULTURE IS BIG BUSINESS IN THE UNITED STATES

By Swepson Earle, Liaison Officer of the U. S. Bureau of Fisheries

THE AVERAGE PERSON observing the fisherman casting his line in a stream and hauling out a fish rarely thinks of the story that may be behind that memorable gesture. In four cases out of five the stream is one of the thousands annually stocked by the State or Federal Governments and the fish has passed through several stages of development from artificial incubation in the wooden troughs of the fish hatchery to nursery ponds where it is artificially fed and finally, but not as often as might be wished, it reaches the size legally prescribed for capture and is released in public fishing waters.

A study of the records convinces one that fish culture in the United States is now big business. From a glance at the accompanying map one might conclude that a rash of fish cultural stations has broken out all over the face of our fair country and that every available spot has been taken over by the hatcheryman for his troughs and ponds. But in view of the fact that these stations are depended upon to satisfy the ever increasing demands of anglers for stocking adjacent waters within a radius of sometimes 200 or 300 miles, it is apparent that the elaborate machinery of fish culture is not yet over developed. These 87 Federal and some 400 State fish hatcheries in 1936 turned out over six billions of young fish but still applications for stocking fishing waters continue to pile up and delays of months or years sometimes occur before they can be filled.



FISH CULTURAL STATIONS OF THE UNITED STATES.

FEDERAL HATCHERIES — ●

STATE HATCHERIES — ⊙

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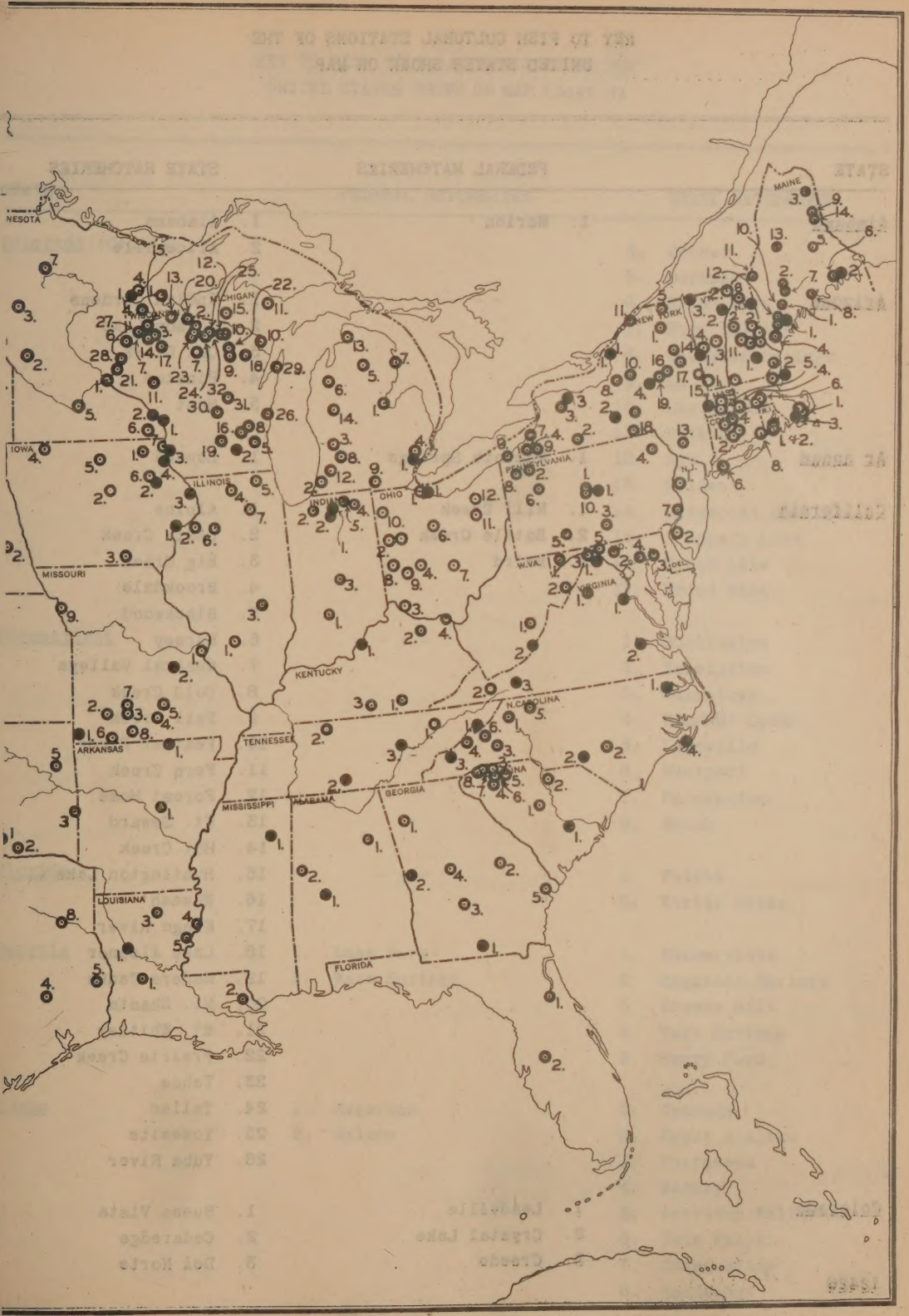
MAINE
MICHIGAN
NEW YORK
IOWA
ILLINOIS
INDIANA
OHIO
PENNSYLVANIA
N.J.
W.VA.
MISSOURI
KENTUCKY
VIRGINIA
N.CAROLINA
TENNESSEE
ARKANSAS
MISSISSIPPI
ALABAMA
GEORGIA
LOUISIANA
FLORIDA

#12426

KEY TO FISH CULTURAL STATIONS OF THE
UNITED STATES SHOWN ON MAP.

STATE	FEDERAL HATCHERIES	STATE HATCHERIES
Alabama	1. Marion	1. Alabama
		2. Aliceville
Arizona	- - -	1. Indian Gardens
		2. Mormon Lake
		3. Oak Creek
		4. Pinetop
		5. Hunt
Arkansas	1. Mammoth Springs	1. Lonoke
California	1. Mill Creek	1. Alpine
	2. Battle Creek	2. Basin Creek
	3. Baird	3. Big Creek
		4. Brookdale
		5. Blackwood
		6. Burney
		7. Central Valleys
		8. Cold Creek
		9. Fall Creek
		10. Feather River
		11. Fern Creek
		12. Forest Home
		13. Ft. Seward
		14. Hot Creek
		15. Huntington Lake
		16. Kaweah
		17. Kings River
		18. Lake Almanor
		19. Madera Tanks
		20. Mt. Shasta
		21. Mt. Whitney
		22. Prairie Creek
		23. Tahoe
		24. Tallac
		25. Yosemite
		26. Yuba River
Colorado	1. Leadville	1. Buena Vista
	2. Crystal Lake	2. Cedaredge
	3. Creede	3. Del Norte

KEY TO FISH CULTURAL STATIONS OF THE
UNITED STATES SHOWN ON MAP (Cont'd)

STATE	FEDERAL HATCHERIES	STATE HATCHERIES
Colorado (Cont'd)		4. Denver
		5. Durango
		6. Estes Park
		7. Fort Collins
		8. Glenwood Springs
		9. La Jara
		10. Las Animas
		11. Pitkin
		12. Rye
		13. Walden
		14. Steamboat Springs
		15. Trappers Lake
		16. Grand Lake
		17. Grand Mesa
Connecticut	- - -	1. Burlington
		2. Kensington
		3. Voluntown
		4. Windsor Locks
		5. Leesville
		6. Westport
		7. Farmington
		8. Noank
Florida	- - -	1. Welaka
		2. Winter Haven
Georgia	1. Lake Park	1. Summerville
	2. Warm Springs	2. Magnolia Springs
		3. Bowens Mill
		4. Tuft Springs
		5. Henry Ford
Idaho	1. Hagerman	1. Cascade
	2. Salmon	2. Coeur d'Alene
		3. Evergreen
		4. Mackay
		5. American Falls
		6. Twin Falls
		7. Grangeville
		8. Sandpoint

KEY TO FISH CULTURAL STATIONS OF THE
UNITED STATES SHOWN ON MAP (Cont'd

STATE	FEDERAL HATCHERIES	STATE HATCHERIES
Illinois	- - -	1. Carlyle 2. Geneseo 3. Mattoon 4. Rockford 5. Spring Grove 6. Wyanet 7. Yorkville
Indiana	1. Rochester 2. Argos	1. Avoca 2. Bass Lake 3. Riverside 4. Tri Lakes 5. Wawasee Fish
Iowa	1. Fairport 2. Manchester 3. Bellevue 4. Marquette	1. (Twin Springs (Sievert Springs 2. Eldora 3. Wapello 4. Spirit Lake 5. Clear Lake 6. Strawberry Point 7. Miss. Rescue Station
Kansas	- - -	1. State Hatchery(Pratt)
Kentucky	1. Louisville	1. Gatliff State 2. Glen Springs 3. Trigg State 4. Ashland State
Louisiana	1. Natchitoches	1. Beechwood 2. Huey P. Long 3. James A. Noe 4. Lake Bruen 5. Lake St. John
Maine	1. Boothbay Harbor 2. Craig Brook	1. Auburn 2. Belgrade 3. Caribou 4. Dry Mills 5. Enfield

KEY TO FISH CULTURAL STATIONS OF THE
UNITED STATES SHOWN ON MAP (Cont'd)

STATE	FEDERAL HATCHERIES	STATE HATCHERIES
Maine (Continued)		6. Tunk Pond
		7. Governor Hill
		8. Knox County
		9. Littleton
		10. Monmouth
		11. Oquossoc
		12. Sebago
		13. Moosehead
		14. Grand Lake Stream
Maryland	- - -	1. Bear Creek
		2. Lewistown
		3. Fairlee
		4. Severn River
		5. Cushwa
Massachusetts	1. Berkshire	1. East Sandwich
	2. Gloucester	2. Harold Parker
	3. Woods Hole	3. Montague
		4. Palmer
		5. Sunderland
		6. Sutton
Michigan	1. Northville	1. Bay City
		2. Benton Harbor
		3. Lydell
		4. Drayton Plains
		5. Grayling
		6. Harriette
		7. Harrisville
		8. Hastings
		9. Hillsdale
		10. Twin Falls
		11. Marquette
		12. Wolf Lake
		13. Oden
		14. Paris
		15. Watersmeet

KEY TO FISH CULTURAL STATIONS OF THE UNITED STATES SHOWN ON MAP (Cont'd)

STATE	FEDERAL HATCHERIES	STATE HATCHERIES
Minnesota	1. Duluth	1. St. Paul
	2. Homer	2. Glenwood
		3. Detroit
		4. French River
		5. St. Peter
		6. Lanesboro
		7. Redby
Missouri	1. Neosho	1. Forest Park
	2. Bourbon	2. Chesapeake
		3. Sequiota
		4. Montauk
		5. Gibbs Lake
		6. Roaring River
		7. Bennett Spring
		8. Taneycomo
		9. Sugar Lake
Mississippi	1. Tupelo	- - -
Montana	1. Bozeman	1. Anaconda
	2. Madison Valley	2. Big Timber
	3. Glacier Park	3. Emigrant
	4. Miles City	4. Hamilton
		5. Great Falls
		6. Lewistown
		7. Libby
		8. Miles
		9. Ovando
		10. Philipsburg
		11. Polson
		12. Somers
Nebraska	1. Crawford	1. Benkelman
		2. Gretna
		3. Valentine
		4. Rock Creek
Nevada	- - -	1. Verdi Fish
		2. Smith Creek

KEY TO FISH CULTURAL STATIONS OF THE
UNITED STATES SHOWN ON MAP (Cont'd).

STATE	FEDERAL HATCHERIES	STATE HATCHERIES
New Hampshire	1. Nashua	1. Center Ossipee
	2. York Pond	2. Colebrook
		3. Georges Mills
		4. Greenland
		5. Laconia
		6. New Hampton
		7. Middleton
		8. Pittsburg
		9. Richmond
		10. Warren
		11. Whitefield
New Jersey	- - -	1. Hackettstown
		2. Tar Hatchery
New Mexico	1. Eagle Nest Lake	1. Lisboa
	2. Dexter	2. Jenks Cabin
	3. Santa Rosa	3. Taos
		4. Park View
		5. Seven Springs
		6. Glenwood Hatchery
New York	1. Cape Vincent	1. Adirondack
	2. Cortland	2. Bath
	3. Rochester	3. Caledonia
	4. Barneveld	4. Chautauqua
		5. Chateaugay
		6. Cold Spring Harbor
		7. Dunkirk
		8. Oneida
		9. Randolph
		10. Rome
		11. St. Lawrence
		12. South Otselic
		13. Summitville
		14. Warrensburg
		15. Washington County
		16. Johnstown
		17. Lake George
		18. Lily Lake
		19. Van Hornesville

KEY TO FISH CULTURAL STATIONS OF THE
UNITED STATES SHOWN ON MAP (Cont'd)

STATE	FEDERAL HATCHERIES	STATE HATCHERIES
North Carolina	1. Edenton	1. Boone
	2. Hoffman	2. Fayetteville
	3. Smokemont	3. Marion
	4. Beaufort	4. Waynesville
		5. Roaring Gap
		6. Mt. Mitchell
North Dakota	- - -	1. Lisbon
Ohio	1. Put-In-Bay	1. State Fish Hatchery
		2. " " Farm No. 1
		3. " " " No. 2
		4. " " " No. 3
		5. " " " No. 4
		6. " " " No. 5
		7. " " " No. 6
		8. " " " No. 7
		9. " " " No. 8
		10. " " " No. 9
		11. " " " No.10
		12. " " " No.11
Oklahoma	1. Tishomingo	1. Byron
		2. Durant
		3. Heavener
		4. Medicine Park
		5. Tahlequah
Oregon	1. Clackamas	1. Alsea Trout
	2. Butte Falls	2. Bandon Trout
		3. Butte Falls Trout
		4. Cedar Creek Trout
		5. Fall River Trout
		6. Hood River Trout
		7. Klamath Trout
		8. McKenzie R. Trout
		9. Necanicum Trout
		10. Oak Springs Trout
		11. Roaring River Trout
		12. Rock Creek Trout

KEY TO FISH CULTURAL STATIONS OF THE
UNITED STATES SHOWN ON MAP (Cont'd)

STATE	FEDERAL HATCHERIES	STATE HATCHERIES
Oregon (Cont'd)		13. Union Trout
		14. Wilamette Trout
		15. Diamond Lake
		16. Wallowa
Pennsylvania	1. Lamar	1. Bellefonte
		2. Corry
		3. Huntsdale
		4. Pleasant Mount
		5. Reynoldsdale
		6. Tionesta
		7. Torresdale
		8. Union City
		9. Erie
		10. Spring Creek
Rhode Island	- - -	1. Goose Nest Spring
		2. Wickford
South Carolina	1. Orangeburg	1. Richardson
		2. Springs Stevens
		3. Berry's Mill
		4. Toney Tucker
		5. Rainbow Lake
		6. O'Neal
		7. Cleveland
		8. Table Rock
South Dakota	1. Spearfish	1. Cleghorn Springs
		2. Pickerel Lake
		3. Kampeska
		4. Lake Side
		5. Lake Byron
		6. Twin Lakes
		7. Lake Andes
Tennessee	1. Erwin	1. Morristown
	2. Flintville	2. Springfield
	3. Norris	
Texas	1. Fort Worth	1. Cisco
	2. Marcos	2. Kerrville

KEY TO FISH CULTURAL STATIONS OF THE
UNITED STATES SHOWN ON MAP (Cont'd)

STATE	FEDERAL HATCHERIES	STATE HATCHERIES
Texas (Cont'd)	3. San Angelo	3. Dallas
	4. Uvalde	4. Huntsville
		5. Jasper
		6. San Angelo
		7. Ingram
		8. Tyler
		9. Olmito
Utah	1. Bear Lake	1. Beaver
	2. Springville	2. Glenwood
		3. Kamas
		4. Loa
		5. Logan
		6. Midway
		7. Salt Lake
		8. Panguitch
		9. Springville
		10. Whiterocks
Vermont	1. Pittsford	1. Bennington
	2. St. Johnsbury	2. Canaan
	3. Lakeside	3. Roxbury
		4. Salisbury
Virginia	1. Fort Belvoir	1. Front Royal
	2. Harrison Lake	2. Marion
	3. Wytheville	
Washington	1. Birdsview	(SALMON HATCHERIES)
	2. Baker Lake	
	3. Mt. Rainier	E. Chehalis
	4. Spokane	J. Chinook
	5. Big White Salmon	
	6. Little White Salmon	
	7. Quinault	
	8. Quilcene	
	9. Duckabush	

KEY TO FISH CULTURAL STATIONS OF THE
UNITED STATES SHOWN ON MAP (Cont'd)

STATE	FEDERAL HATCHERIES	STATE HATCHERIES
Washington (Cont'd)		M. Cowlitz River
		G. Dungeness
		D. Green River
		K. Kalama
		O. Lewis River
		I. Nasel River
		A. Nooksack
		N. Puyallup River
		B. Samish
		C. Skykomish
		H. Willapa
		L. Wind River
		(GAME FISH HATCHERIES)
		1. Aberdeen
		2. Bellingham
		3. Chelan
		4. Chiwaukum
		5. Colville
		6. Kittitas
		7. Lake Crescent
		8. Lake Whatcom
		9. Naches
		10. Pend Oreille
		11. San Poil
		12. Seward Park
		13. Skamania
		14. South Tacoma
		15. Spokane
		16. Tokul Creek
		17. Vancouver
		18. Walla Walla
West Virginia	1. Leetown	1. Marlinton
	2. White Sulphur Springs	2. Petersburg
		3. State Bass (Ridge)
Wisconsin	1. La Crosse	1. Bayfield
	2. Lake Mills	2. Big Lake
	3. Lynxville	3. Birchwood
		4. Brule
		5. Burlington

KEY TO FISH CULTURAL STATIONS OF THE
UNITED STATES SHOWN ON MAP (Cont'd)

STATE	FEDERAL HATCHERIES	STATE HATCHERIES
Wisconsin (Cont'd)		6. Clam Lake
		7. Crystal Springs
		8. Delafield
		9. Deerbrook
		10. Eagle River
		11. Eau Claire
		12. Fishtrap Lake
		13. Glidden
		14. Haugen
		15. Hayward(2 hatcheries)
		16. Hebron
		17. Island Lake
		18. Lakewood
		19. Madison
		20. Mercer
		21. Osceola
		22. Pelican Lake
		23. Pine Lake
		24. Rest Lake Dam
		25. Sayner
		26. Cheboygan
		27. Spooner
		28. St. Croix Falls
		29. Sturgeon Bay
		30. Westfield
		31. Wild Rose
		32. Woodruff
Wyoming	1. Jackson	1. Laramie
	2. Lake Station	2. Cokeville
	3. Saratoga	3. Hyattsville
		4. Story
		5. Cody
		6. Daniel
		7. Blue Hole

During the fiscal year 1936, the Federal Bureau employed 272 men who received $378,080 for their services. In addition, $630,250 was expended for the maintenance and operation of its stations. Thirty-seven states report a total investment of over $12,000,000 in hatchery grounds, buildings, and equipment and over two and two-thirds million dollars are spent annually in operating these establishments. These same states employ 1,628 men in the business of hatching, rearing, and distributing fish with an annual payroll of $1,525,000. The states are individually and collectively in the fish cultural business in a large way.

During the past decade there has been a gradual expansion of the Federal fish cultural system through the establishment of stations in regions not adequately served and many states have been able to develop and enlarge their hatchery facilities through Federal aid and thereby increase the output of fish. In addition to the stocking of streams and lakes to lure the tired business man from his desk for health-giving recreation in the great outdoors, these fish cultural stations, improved and beautified, are visited by the general public in increasing numbers. The opportunity is thus presented to supply the visitors with information relative to fish propagation activities, fishery regulations, and conservation work generally and the stations have added their bit to the general movement to preserve Nature for all to enjoy.

The map and the following tables tell their own story although the figures require considerable explanation to present a complete story of the far-flung operations and the intricate ramifications of fish culture as the handmaiden of conservation.

Table 1 gives a summary by species of the output of fish during the fiscal year 1936 by the U. S. Bureau of Fisheries. It will be noted that total production amounted to two and three-quarter billions of fish which is a staggering number and surely sufficient to satisfy the most ardent angler. Figures do not lie but the reader should not deceive himself with the belief that such a tremendous hatchery production assures him a full creel on his next fishing trip. More than two and a half billion of this total consisted of commercial species and more than half of this number were flatfish or flounders planted in the coastal waters of New England. A goodly number were pollock, cod, haddock, and mackerel -- commercial fishes of New England -- representing a salvage of eggs that would otherwise be wasted by the commercial fishery. Yellow perch yield over 300,000,000 fry and whitefish, shad, lake herring, and other commercial fish that produce eggs in tremendous quantities greatly augment the total. The angler, however, is more interested in game fish, such as trout, bass, and other warm water fishes. Although the production of trout is not inconsiderable, most of them being distributed as fingerlings and larger fish with tremendously increased chances of survival, the smaller pan fish, such as crappie and sunfish, are produced in much larger numbers.

Table 2 presents a summary of fish production by the various states. Again it will be noted that fry out-number fingerlings and adults by 13 to 1. Wisconsin, Minnesota, Ohio, Pennsylvania, and New York, in this relative order, produce the greatest quantities of fry in which the lake fishes, such as yellow perch, walleyed pike, whitefish, and lake herring, predominate but in the production of fingerlings and adults, California leads the list with Montana, Colorado, Oregon, and Wisconsin in following order. In this category are found trout, salmon, grayling, and the warm water fishes liberally represented.

Table 1 - Summary, by species, of the output of fish during the fiscal year ending June 30, 1936 by U. S. Bureau of Fisheries 1/

Species	Fry	Fingerlings	Total
Catfish	---	6,673,000	6,673,000
Buffalofish	---	1,218,255	1,218,255
Carp	---	3,277,600	3,277,600
Shad	12,150,000	---	12,150,000
Whitefish	38,080,000	---	38,080,000
Lake Herring	2,740,000	---	2,740,000
Chinook salmon	21,240	53,607,860	53,629,100
Chum salmon	14,139,000	9,070	14,148,070
Silver salmon	344,580	4,990,740	5,335,320
Sockeye salmon	11,038,000	6,577,500	17,615,500
Steelhead trout	---	809,000	809,000
Atlantic salmon	---	560,000	560,000
Landlocked salmon	67,500	709,870	777,370
Rainbow trout	---	12,136,400	12,136,400
Blackspotted trout	---	12,003,310	12,003,310
Loch Leven trout	1,105,000	4,576,360	5,681,360
Lake trout	713,460	113,575	827,035
Brook trout	836,000	12,938,650	13,774,650
Grayling	4,897,500	272,700	5,170,200
Pike and pickerel	---	775,150	775,150
Crappie	---	16,188,250	16,188,250
Black bass, largemouth	622,500	3,641,160	4,263,660
Black bass, smallmouth	1,255,000	270,100	1,525,100
Rock bass	---	121,680	121,680
Warmouth bass	---	53,160	53,160
Sunfish	---	17,504,300	17,504,300
Pike perch	9,670,000	---	9,670,000
Yellow perch	307,958,000	147,000	308,105,000
Freshwater drum	---	3,400	3,400
White bass	---	17,000	17,000
Miscellaneous fishes	---	1,416,400	1,416,400
Mackerel	1,334,000	---	1,334,000
Cod	261,662,000	---	261,662,000
Haddock	9,588,000	---	9,588,000
Flatfish (flounder)	1,435,283,000	---	1,435,283,000
Pollock	475,457,700	---	475,457,700
Total	2,588,962,480	160,611,490	2,749,573,970

1/ In addition to these fry and fingerlings the Bureau distributed 5,421,626,000 fertilized eggs of various species of which 3,416,-733,000 were from cod.

Table 2 - Summary of Annual Distribution of Fish by Thirty-seven States

State	Fry	Fingerlings and Adult	Total
Alabama	---	1,620,098	1,620,098
Arizona	---	1,464,947	1,464,947
California	---	43,571,000	43,571,000
Colorado	---	22,203,825	22,203,825
Connecticut	65,310,410	1,476,199	66,786,609
Florida	---	1,100,000	1,100,000
Illinois	---	8,884,000	8,884,000
Indiana	---	1,694,383	1,694,383
Iowa	85,300,000	1,724,079	87,024,079
Louisiana	---	1,380,000	1,380,000
Maryland	283,252,400	496,060	283,748,460
Massachusetts	119,000	1,927,667	2,046,667
Michigan	208,896,955	17,776,903	226,673,858
Minnesota	494,572,555	8,357,843	502,930,398
Missouri	---	2,769,405	2,769,405
Montana	3,308,330	30,318,555	33,626,885
Nebraska	2,369,000	830,161	3,199,161
New Hampshire	1,588,500	1,327,126	2,915,626
New Jersey	130,062,250	2,502,396	132,564,646
New Mexico	---	3,622,987	3,622,987
New York	296,779,551	12,723,572	309,503,123
North Dakota	6,180,000	30,900	6,210,900
Ohio	341,820,000	4,442,001	346,262,001
Oklahoma	2,209,800	1,608,125	3,817,925
Oregon	---	20,728,340	20,728,340
Pennsylvania	312,791,400	6,026,201	318,817,601
South Carolina	2,000,000	1,000,000	3,000,000
South Dakota	13,000,000	2,729,021	15,729,021
Tennessee	---	696,500	696,500
Texas	---	4,426,444	4,426,444
Utah	---	8,000,000	8,000,000
Vermont	34,134,080	2,110,987	36,245,067
Virginia	3,524,500	981,180	4,505,680
Washington	188,139,200	---	188,139,200
West Virginia	---	3,112,575	3,112,575
Wisconsin	554,563,987	17,705,136	572,269,123
Wyoming	---	9,618,000	9,618,000
Total	3,029,921,918	250,986,616	3,280,908,534

Table 3 presents the hatchery production of 37 states according to species and size produced. In point of numbers alone the Great Lakes states produce the greatest quantity of commercial lake fishes for the reasons already mentioned. The Pacific Coast states produce great numbers of salmon. In the states of Connecticut, Iowa, Massachusetts, Montana, New Jersey, New York, Pennsylvania, and Wisconsin, fish culture is most diversified for these states are engaged in hatching the greatest variety of species. The states of the far South naturally concentrate on the production of warm water fish, such as bass and pan fish; whereas the inter-mountain states, with some exceptions, specialize in trout.

Unfortunately the figures of production in the various states cannot be directly compared in estimating the total effectiveness of the states' fish cultural system. In many of the eastern states trout are reared to legal size before being planted in the streams while in the West the planting of smaller fingerlings or fry is more generally practiced. There is no way at present to determine the relative equivalent from the angler's standpoint of planting fry or larger fish in the streams and the tabulation here presented does not indicate the numbers of fish at the various sizes produced. Hence the tabulation cannot be regarded as an index of fishing conditions in the various states. That question is still a part of the lure that induces many a tourist to carry his fishing kit with him on a cross-country trip.

Table 3 - Hatchery Production of Thirty-Seven States

State and Year	Species	Fry	Fingerlings and Adults	Totals
Alabama	Bass	---	445,786	
Calendar year 1936	Bluegill	---	1,174,312	1,620,098
Arizona	Bass	---	80,100	
Calendar year 1936	Crappie	---	6,300	
	Bluegill	---	113,200	
	Rainbow Trout	---	750,448	
	Loch Leven Trout	---	11,224	
	E. Brook Trout	---	313,575	
	Black Spotted Trout	---	190,100	1,464,947
California	Trout	---	35,655,000	
Calendar year 1935	Salmon	---	7,865,000	
	Smallmouth Bass	---	51,000	43,571,000
Colorado	Trout	---	22,203,825	22,203,825
Calendar year 1936				

Table 3 (Continued)

State and Year	Species	Fry	Fingerlings and Adults	Totals
Connecticut	Trout	44,000	361,282	
Calendar year 1936	Largemouth Bass	---	143	
	Smallmouth Bass	---	959	
	Pickerel	---	702	
	Yellow Perch	---	46,570	
	White Perch	---	888	
	Bullheads	---	527,463	
	Calico Bass	---	145,141	
	Shiners	---	359,902	
	Roach	---	30,787	
	Crawfish	---	2,362	
	Yellow Perch	10,500,000	---	
	Shad	8,894,000	---	
	Smelt	26,098,800	---	
	Flounders	19,773,610	---	66,786,609
Florida	Black Bass	---	1,100,000	1,100,000
Illinois	Bass	---	288,000	
Fiscal year 1936	Crappie	---	62,000	
	Bluegill	---	3,559,000	
	Lake Trout	---	4,000,000	
	Perch	---	975,000	8,884,000
Indiana	Black Bass	---	439,761	
	Crappie	---	3,950	
	Bluegill	---	1,146,997	
	Sunfish	---	103,675	1,694,383
Iowa	Trout	---	117,960	
Calendar year 1936	Bullheads	---	558,496	
	Bluegill	---	257,611	
	Catfish	---	52,942	
	Crappie	---	262,251	
	Largemouth Bass	---	190,070	
	Smallmouth Bass	---	13,400	
	Pike	85,300,000	190,703	
	Pickerel	---	1,021	
	Silver Bass	---	525	
	Pumpkinseed	---	4,800	
	Perch	---	4,100	
	Shiners	---	68,700	
	Minnows	---	1,500	87,024,079

Table 3 (Continued)

State and Year	Species	Fry	Fingerlings and Adults	Totals
Louisiana	Large and smallmouth Bass, Bluegill, and Crappie	—	1,380,000	1,380,000
Maryland	Largemouth Bass	—	255,300	
Fiscal year	Bluegill	—	130,000	
Sept. 30, 1935 to	Pike	—	760	
Oct. 1, 1936	Brook and Brown Trout	—	110,000	
	Shad	1,702,400	—	
	Herring	6,640,000	—	
	White Perch	65,360,000	—	
	Yellow Perch	209,550,000	—	283,748,460
Massachusetts	Horned Pout	—	242,245	
Fiscal year	Crappie	—	219,060	
Dec. 1, 1935 to	Pickerel	—	5,821	
Nov. 30, 1936	Yellow Perch	—	83,674	
	White Perch	—	116,695	
	Smallmouth Bass	—	55,584	
	Bluegill	—	164,990	
	Pike Perch 1/	119,000	375	
	Brook Trout	—	653,484	
	Brown Trout	—	205,326	
	Rainbow Trout	—	141,513	
	Chinook Salmon	—	39,000	2,046,667
Michigan	Brook Trout	—	3,924,192	
Calendar year 1936	Brown Trout	140,000	3,418,749	
	Rainbow Trout	117,955	862,796	
	Lake Trout	3,344,000	165,000	
	Largemouth Bass	30,000	595,207	
	Smallmouth Bass	—	254,496	
	Bluegill	—	6,881,789	
	Yellow Perch	—	1,803,050	
	Wall-eyed Pike	205,265,000	11,624	226,673,858
Minnesota	Bass	—	271,518	
Fiscal year 1936	Crappie	—	43,330	
	Bluegill	—	143,625	
	Brook Trout	—	2,030,733	

1/ Period from Dec. 1, 1934 to Nov. 30, 1935.

Table 3 (Continued)

State and Year	Species	Fry	Fingerlings and Adults	Totals
Minnesota (Cont'd)	Brown Trout	---	900,884	
	Loch Leven Trout	---	396,070	
	Rainbow Trout	---	1,374,783	
	Lake Trout	---	3,196,900	
	Herring	440,000	---	
	Wall-eyed Pike	489,159,555	---	
	Pickerel	2,973,000	---	
	Miscellaneous	2,000,000	---	502,930,398
Missouri	Bass	---	609,514	
	Crappie	---	523,947	
	Bluegill	---	735,250	
	Green Sunfish	---	637,106	
	Catfish	---	162,989	
	Goggle eye	---	10,600	
	Trout	---	90,000	2,769,405
Montana	Bass	---	241,461	
Fiscal year 1935-36	Crappie	---	49,032	
	Bluegill	---	39,276	
	Salmon	---	470,217	
	Sockeye Salmon	3,308,330	---	
	Steelhead Salmon	---	12,624	
	Native Trout	---	7,535,877	
	Rainbow Trout	---	6,786,030	
	Grayling	---	10,955,044	
	Brook Trout	---	1,795,946	
	Loch Leven	---	2,059,320	
	Golden Trout	---	2,000	
	Albino Brook	---	1,500	
	Catfish	---	13,660	
	Perch	---	56,568	
	Pike	---	300,000	33,626,885
Nebraska	Largemouth Bass	---	330,000	
Calendar year 1936	Crappie	---	200,000	
	Bluegill	---	120,000	
	Rainbow Trout	130,000	170,000	
	Brook Trout	30,000	10,000	
	Channel Catfish	159,000	161	
	Wall-eyed Pike	2,050,000	---	3,199,161

Table 3 (Continued)

State and Year	Species	Fry	Fingerlings and Adult	Totals
New Hampshire	Brook Trout	931,000	780,174	
	Rainbow Trout	135,000	272,687	
	Lake Trout	422,500	164,090	
	Aureolus Trout	100,000	15,500	
	Brown Trout	---	40,775	
	Landlocked Salmon	---	53,900	2,915,626
New Jersey	Brook Trout	---	514,041	
Fiscal year 1936	Brown Trout	---	615,673	
	Rainbow Trout	---	575,289	
	Largemouth Bass	---	343,468	
	Smallmouth Bass	---	36,000	
	Catfish	---	33,775	
	Sunfish	---	2,900	
	Bluegill	---	381,000	
	Crappie	---	250	
	Yellow Perch	123,800,250	---	
	White Perch	32,000	---	
	Shad	6,230,000	---	132,564,646
New Mexico	Rainbow Trout	---	1,851,794	
Fiscal year 1936	Loch Leven Trout	---	32,500	
	Black Spotted Trout	---	1,470,693	
	Eastern Brook Trout	---	268,000	3,622,987
New York	Large & smallmouth Bass	---	1,361,248	
Fiscal year 1936	Crappie	---	15,165	
	Bluegill	---	580	
	Landlocked Salmon	---	23,083	
	Brown Trout	---	3,780,709	
	Rainbow Trout	---	1,102,914	
	Lake Trout	---	1,621,956	
	Brook Trout	---	4,148,419	
	Bullheads	---	109,748	
	Muskellunge	5,471,801	---	
	Yellow Perch	---	559,750	
	Pike Perch	206,790,000	---	
	Shad	2,797,750	---	
	Herring	58,500,000	---	
	White Fish	23,220,000	---	309,503,123

Table 3 (Continued)

State and Year	Species	Fry	Fingerlings and Adults	Totals
North Dakota	Bass	—	6,900	
Calendar year 1936	Crappie	—	3,500	
	Bluegill	—	10,400	
	Bullheads	—	3,300	
	Bream	—	4,500	
	Perch	—	2,300	
	Wall-eyed Pike	730,000	—	
	Northern Pike	5,450,000	—	6,210,900
Ohio	Bass	—	678,148	
	Crappie	—	94,975	
	Bluegill	—	1,312,010	
	Rock Bass	—	8,274	
	Forage Fish	—	1,575,586	
	Catfish	—	768,469	
	Perch & Pike Perch	—	3,602	
	Suckers	—	937	
	Whitefish	150,440,000	—	
	Yellow-Pike-Perch	191,380,000	—	346,262,001
Oklahoma	Largemouth Bass	1,873,800	198,400	
Calendar year 1935	Crappie	—	419,000	
	Bluegill	—	476,000	
	Smallmouth Bass	—	1,500	
	Channel Catfish	436,000	282,750	
	Goggle-eye Perch	—	99,000	
	Warmouth Bass	—	36,300	
	Bullhead Catfish	—	35,300	
	Texas Bream	—	32,900	
	Rock Bass	—	22,375	
	Ringed Perch	—	2,600	
	Yellow Perch	—	2,000	3,817,925
Oregon	Rainbow Trout	—	8,955,750	
Fiscal year 1936	Steelhead Trout	—	2,295,090	
	Eastern Brook Trout	—	6,690,900	
	Cutthroat Trout	—	1,830,500	
	Loch Leven Trout	—	435,000	
	Silversides Trout	—	456,100	
	Chinook	—	65,000	20,72 8,340

Table 3 (Continued)

State and Year	Species	Fry	Fingerlings and Adults	Totals
Pennsylvania	Trout	---	3,859,900	
Calendar year 1936	Bass	---	180,468	
	Catfish	---	261,100	
	Sunfish	---	374,106	
	Pickerel	---	1,637	
	Suckers	---	11,116	
	Minnows	---	921,800	
	Carp	---	20,101	
	Muskellunge	---	1,171	
	Bullfrogs (tadpoles)	---	364,800	
	Eels	---	30,002	
	Yellow Perch	256,612,000	---	
	Pike Perch	12,477,400	---	
	Whitefish	14,000,000	---	
	Blue Pike	21,242,000	---	
	Cisco	8,460,000	---	318,817,601
South Carolina	- - -	---	---	3,000,000
South Dakota	Bass, Crappie, and			
Fiscal year 1936	Sunfish	---	291,194	
	Ring Perch	---	247,871	
	Catfish	---	991,534	
	Great Northern Pike	---	152,950	
	Wall-eyed Pike	13,000,000	---	
	Trout	---	1,045,472	15,729,021
Tennessee	Bass	---	136,500	
Fiscal year 1936	Bluegill	---	77,000	
	Trout	---	483,000	696,500
Texas	Bass	---	965,000	
Fiscal year 1936	Crappie	---	74,844	
	Bluegill and other Sunfish	---	3,386,600	4,426,444
Utah	Trout	---	8,000,000	8,000,000
Vermont	Brook Trout	34,080	1,282,824	
Fiscal year 1936	Brown Trout	---	211,225	
	Landlocked Salmon	---	144,650	

Table 3 (Continued)

State and Year	Species	Fry	Fingerlings and Adults	Totals
Vermont (Cont'd)	Lake Trout	---	217,356	
	Atlantic Salmon	---	8,000	
	Rainbow Trout	---	189,280	
	Steelhead Trout	---	6,888	
	Loch Leven	---	5,839	
	Black Bass	---	43,550	
	Catfish	---	375	
	Pike Perch	16,500,000	---	
	Yellow Perch	17,600,000	---	36,245,067
Virginia Fiscal Year 1936	Smallmouth Bass	---	77 740	
	Largemouth Bass	---	15,870	
	Crappie	---	23,125	
	Bluegill	---	399,612	
	Shiners	---	60,900	
	Rock Bass	---	2,500	
	Brook and Rainbow Trout	---	401,433	
	Shad (fertilized eggs)	3,524,500	---	4,505,680
Washington Fiscal year April 1, 1935 to March 31, 1936	Salmon (eggs) 1/	---		188,139,200
West Virginia Fiscal year 1936	Bass	---	37,740	
	Bluegill	---	27,280	
	Trout	---	3,047,555	3,112,575
Wisconsin Calendar year 1936	Brook Trout	---	2,984,197	
	Brown Trout	---	2,622,442	
	Rainbow Trout	---	1,510,592	
	Lake Trout	26,690,300	---	
	Wall-eyed Pike	423,000,000	140,957	
	Muskellunge	6,997,000	1,870	
	Perch	85,225,000	1,240,998	
	Crappie	8,134,787	1,993,515	
	Bluegill	4,516,900	1,054,765	
	Black Bass	---	1,097,553	
	Rock Bass	---	5,935	

1/ Record of egg take only.

Table 3 (Continued)

State and Year	Species	Fry	Fingerlings and Adults	Totals
Wisconsin (Cont'd)	White Bass	—	195,354	
	Sunfish	—	1,531,869	
	Bullhead	—	3,072,120	
	Northern Pike	—	246,389	
	Catfish	—	6,448	
	Sturgeon	—	132	572,269,123
Wyoming Calendar year 1936	Trout all species	—	9,618,000	9,618,000
		GRAND TOTAL		3,280,908,534

Tables 4 and 5 give some measure of fish culture among the states as a business enterprise. Just how these statistics may be interpreted is left to the reader's judgment. Fish cultural methods are so little standardized throughout the country, fish cultural technique has developed so irregularly during the past fifty years, and local conditions and requirements are so different in the various sections of the country that detailed analysis inviting invidious comparisions would be unwarranted. Suffice it to say that the evidence convinces one that fish culture is a well-developed and highly specialized enterprise that reflects the generally high regard of the people at large for one of the most direct and positive forces in fishery conservation.

Table 4 - Capital Invested and Cost of Operations, State Fish Hatcheries 1/

State	Cost of Operations	Capital Invested
Alabama	$ 8,985.79	$40,000.00
Arizona	11,639.62	42,500.00
California	306,000.00	750,000.00
Colorado	78,564.00	1,085,500.00
Connecticut	63,091.47	167,000.00
Florida	6,705.36	15,000.00

Table 4 (Continued)

State	Cost of Operations	Capital Invested
Illinois	30,000.00	125,000.00
Indiana	40,000.00	350,000.00
Iowa	88,000.00	500,000.00
Louisiana	15,900.00	196,742.00
Maryland	15,477.42	48,000.00
Massachusetts	26,753.05	---
Michigan	275,000.00	1,196,125.00
Minnesota	112,221.45	414,687.12
Mississippi	---	---
Missouri	39,923.49	316,186.14
Montana	71,400.33	265,711.42
Nebraska	28,000.00	170,000.00
New Hampshire	99,236.99	225,000.00
New Jersey	85,000.00	500,000.00
New Mexico	68,335.07	98,140.10
New York	280,609.00	500,000.00
North Carolina	28,952.00	150,000.00
North Dakota	3,600.00	1,000.00
Ohio	150,000.00	400,000.00
Oregon	90,904.53	211,895.39
Pennsylvania	251,949.35	1,940,160.00
South Carolina	6,000.00	244,553.80
South Dakota	30,000.00	100,000.00
Tennessee	2,858.23	40,000.00
Texas	42,000.00	500,000.00
Utah	32,750.00	---
Vermont	54,386.55	78,500.00
Virginia	45,750.00	150,000.00
Washington	92,915.00	1,200,000.00
West Virginia	33,400.01	175,000.00
Wisconsin	170,878.48	900,000.00
Wyoming	35,000.00	136,190.00
Totals	$2,693,998.19	$12,357,890.97

1/ Cost of operations reported by thirty-seven States.
" " investment " " thirty-five "

Table 5 - Fish Cultural Personnel and Payroll of the States Reporting

State	Administrative	Fish Culturists	Labor 1/	Total Payroll
Alabama	1	1	57	$ 6,124.44
Arizona	1	3	1	7,510.00
California	22	60	36	165,898.72
Colorado	2	18	10	49,250.00
Connecticut	6	5	18	30,500.00
Florida	2	---	3	4,446.00
Illinois	4	1	---	9,000.00
Indiana	1	1	20	---
Iowa	5	5	78	34,559.76
Louisiana	5	1	5	15,900.00
Maryland	1	4	5	7,499.20
Massachusetts	9	7	---	36,904.25
Michigan	19	56	43	124,283.32
Minnesota	6	7	16	35,880.00
Missouri	10	2	16	18,600.00
Montana	1	12	14	38,388.27
Nebraska	1	4	7	15,148.00
New Hampshire	8	1	29	99,236.99
New Jersey	5	---	175	34,000.00
New Mexico	1	5	10	14,277.00
New York	7	1	190	165,524.00
North Carolina	6	1	6	12,359.00
North Dakota	1	---	3	1,900.00
Ohio	13	---	75	90,000.00
Oklahoma	5	4	2	13,680.00
Oregon	2	15	41	58,116.29
Pennsylvania	9	16	82	129,702.29
South Carolina	1	2	9	7,500.00
South Dakota	1	1	8	15,000.00
Tennessee	1	---	---	5,571.19
Texas	---	---	---	42,000.00

Table 5 (Continued)

State	Administrative	Fish Culturists	Labor 1/	Total Payroll
Utah	1	10	10	16,585.00
Vermont	5	---	45	23,253.72
Virginia	---	---	---	20,035.70
Washington	1	1	82	43,649.40
West Virginia	3	---	---	14,322.50
Wisconsin	20	15	65	99,183.79
Wyoming	8	---	15	19,054.23
Totals	194	258	1,176	$1,524,843.06

1/ Labor may include C.C.C.-W.P.A.-skilled, unskilled or temporary.

GLIMPSES OF FISHERY BIOLOGY AND FISH CULTURE IN EUROPE

I. THE SCANDINAVIAN COUNTRIES

By William E. Ricker, Pacific Biological Station, Nanaimo, B. C.

DR. C. M. MCCAY'S very interesting article in THE PROGRESSIVE FISH CULTURIST (#14), concerning fish culture on the other side of the Atlantic, has led the writer to offer his own observations, made during a five-months' visit (November, 1935 to March, 1936). Fresh water and anadromous fishes have been our principal interest, so it is with fresh water biological stations and government departments controlling lake and stream fisheries that these observations are chiefly concerned.

At the beginning, however, we cannot escape a salty flavour. Our first port of call was the old Hanseatic city of Bergen on the west coast of Norway, where sea fisheries play as important a part in the life of the people as at Prince Rupert, B. C. And so it has been for centuries; in an old, medieval merchant's dwelling, now made a museum, we were shown several dried codfish and sturgeon suspended from the ceiling as a symbol of good luck. Opposite the main pier is the fish market, where one may purchase all the products of the sea -- not fish alone, but also flesh and fowl. The flesh was that of small whales, sliced off as you ordered it, and (we were told) usually very tender and tasty. The fowls were razor-billed auks, guillemots, eider ducks and even cormorants.

After the journey over Norway's mountain chain, through desolate yet beautiful snowfields far above the tree line, we arrived at Oslo, the capital city. Here, in the Natural History Museum, genial Professor Doctor Knut Dahl is at home. Professor Dahl is Director of the Institute for Fresh Water Fisheries Research and the author of a long series of articles on Norwegian fishes and fisheries, particularly salmon and trout. He was the first to apply to fresh waters the Petersen method of estimating a fish population: a sample of 100 or so trout was seined from a lake, marked and returned to the water; several days later a second seining was done, and from the proportion of marked fish taken then, the total trout in the lake were estimated with considerable accuracy. More recently, certain trout waters of Norway have received detailed biological examination by Dr. O. Olstad, and the wanderings and migration of trout in a river system have been studied by Dr. J. Somme, both under the auspices of the Fresh Water Research. Much of Professor Dahl's time has been spent on the study of the lake environment of trout. Particularly, the changes in food organisms which occur when a lake is damned for hydroelectric purposes have been studied. In one such lake it was found that while lowering of the water level in winter killed many of the more sedentary shoreward organisms, certain others increased to such an extent that they allowed trout to make more rapid growth than formerly as a result of the extra food supply. One of the organisms which showed a marked increase was Leipdurus glacialis, a rather large primitive crustacean which occurs also in Arctic America. The habits and occurrence of this important trout food were recently described by Dr. Sven Somme. This work and his others on dragon flies and amphipods are part of an ambitious plan to prepare similar accounts of all of the important food organisms in Norwegian streams and lakes -- no light task, even where the fauna is relatively a limited one.

As regards salmon, Professor Dahl keeps a watchful eye on the catch statistics and spawning escapements to the Norwegian rivers. Several times marking or tagging programs have been attempted, using smolts or adult salmon, to unravel the migration routes of these fish and determine the intensity of the fishery. The most recent of these used near-adult salmon taken from bag nets on the west coast; recaptures were made at various points along the coast and in three foreign countries -- southern Sweden, Scotland, and the White Sea coast of Russia. The last fish made the most extended migration -- 1,550 miles -- and at an average speed of 30 miles per day. Another of Dr. Dahl's discoveries was a Norwegian race of fresh water salmon, or "blege", similar to but much smaller than the Canadian ouananiche.

Another fresh water biologist of Oslo is Dr. Kaare Munster Strom. Unfortunately we did not meet Dr. Strom personally, but his study of the Norwegian lake, Feforvatn, is familiar to anyone interested in the comparative study of lakes.

The University of Oslo has a new site in the suburb, Blindern, and several fine new buildings have been erected. Head of the department of Botany is the distinguished Professor Dr. H. H. Gran, a well known figure at several biological stations of this continent. With an assistant, Dr. Trygve Braarud, he recently made a study of the phytoplankton and other features of the Fundy region of our coast at the request of the International Passamaquoddy Fisheries Commission.

In Sweden, Stockholm and the two university cities, Upsala and Lund, were visited. In the capital city we made the acquaintance of Dr. Gunnar Alm, who administers the Swedish fresh water fisheries. He is a small man, very pleasant and incisive in manner, who obviously approaches his work with an energy and continuous enthusiasm that few can hope to equal. Dr. Alm's time nowadays is divided between administrative work and research work, the latter unfortunately getting rather the worst of it. Nevertheless he has a long series of studies to his credit. Perhaps the best known is his comparison of the botton fauna and the annual fish production of various Swedish lakes, from which he deduced that different ratios of fish food to fish production were characteristic of different types of lakes -- a point of obvious importance in estimating the optimum rate of exploitation for any particular body of water. In spite of the importance of the commercial fisheries of our eastern lakes, there is as yet no comparable American work along these lines. In recent years Dr. Alm has been working hard for international control and regulation of the salmon fisheries of the Baltic sea — a task complicated by the great diversity of nations which border on that body of water. There is considerable artificial propagation of salmon and sea trout in Swedish rivers and a controlled experiment is under way to determine its actual efficiency in the case of the trout.

At the new Drottningholm research institute of which Dr. Alm is director, there are two full-time workers as well as seasonal assistants. Dr. Orvar Nybelin is pathologist and parasitologist. One of his investigations concerns the "crab pest" or fungus disease of crayfish which, first appearing in epidemic proportions early in this century, has persisted endemically and kept their populations at a permanently low level. (It should be mentioned that the European crayfish is highly esteemed as food being larger than most American species.) Dr. Sten Vallin, who was away at the time of our visit, handles the chemical and pollution studies. Life-history investigations of pike and sea trout have recently been made by Dr. Christian Hessle.

Whereas in Norway sea fish are a staple food, in Sweden fresh water species are most easily obtained. Their resources are probably more intensively exploited than ours, but a system of private control of limited areas of the fishing waters puts a check on overfishing: a fisherman who can fish on his own water and no other will usually take care to see that adequate breeding stocks are maintained. On the Stockholm market can be found a great variety of species, some of them identical with or very similar to ours: pike, zander (yellow pickerel), burbot (our wrongfully-despised ling), small whitefish, saibling (arctic char), brown trout, salmon, and eels. Conspicuously absent are ciscoes, suckers and any kind of bass or sunfish, these being native Americans.

Our stay at Upsala, university town and former home of the celebrated Karl von Linne, was regretably short. We spoke for a few minutes with Professor Dr. Sven Ekman, designer of the bottom sampler which bears his name. Of late years Dr. Ekman has pursued his study of glacial and other relicit faunas and recently published a comprehensive text-book on the "Animal Geography of the Sea". Fil.-mag. Tage Borgh, his "amanuens", has studied the fauna of Swedish trout streams.

Lund, university town of southern Sweden, is the home of the well-known limnological institute, formerly directed by Professor Dr. Einar Naumann. The untimely deaths of Professor Naumann and his associate, Dr. Georg Lonnerblad, were blows from which the institute had not yet fully recovered at the time of our visit. Acting Director, Professor Dr. Torsten Gislen, introduced us to two graduate students, Borje Calin-Nilsson and Tore Almstedt, and to Docent Dr. Karl Lang. Professor Naumann and his associates will perhaps be remembered most for their development of the study of regional limnology: the classification of lakes on the basis of general biological production and specific faunal and physico-chemical pecularities, with emphasis upon the basic geological factors which are so important in determining these matters. The institute's field laboratory at Aneboda is in an ideal situation for such a study being surrounded by small lakes of various types and stages of oligotrophy and dystrophy and not too remote from the larger eutrophic lakes of the central plain. Full advantage has been taken of this opportunity and the lakes of the Aneboda region are well known to limnologists everywhere. It is interesting to notice that the Swedish words dy (pronounced "due") for the light grey ooze of eutrophic lakes, and gyttja ("yootya") for the dark, poorly decomposed bottom of humus lakes are now of international currency.

The fresh water fisheries of Denmark, a country of small lakes and short river systems, are much less important than those of Sweden. The Danes have, however, done something with the artificial propagation of salmon and trout, and from various kinds of indirect evidence Drs. J. B. Jacobsen and A. C. Johansen, as well as Dr. Erik M. Poulsen, have concluded that the methods employed benefit the fishery to a degree which is economically profitable. A considerable industry is made of raising trout artificially for the central European market. For this purpose rainbow trout are preferred to the native brown trout because they become large enough for sale in two years. Incidentally there has been as much controversy in Europe as here over the proper name of the "Regenbogenforellen"; one writer has despaired of ever identifying their hatchery stocks with any American race of rainbows, and so has described the new variety "germanica".

But the characteristic Danish fish is the eel. Eel traps are common on their streams and the eel fishery takes precedence over others. We were amused to read in one of Dr. Otterstrom's papers how the traps interfere with the smolt migration of salmon and trout. The only remedy suggested was that at times when eels were not running in any numbers the traps be left open to allow the passage of the smolts and for the rest he hoped for the best. Doubtless the comparative value of the two fisheries makes this a logical attitude but to us it sounds rather like keeping trout out of a stream lest they interfere with the propagation of suckers. It must be admitted, however, that smoked eel on "smorebrod" is very tasty.

With this background, it is not surprising that Danish scientists were the ones who did most to unravel the life history of the eel -- its long migrations from and to the Sargasso sea, with the peculiar metamorphosis from transparent leptocephalus to snake-like elver. It is for this work that the late Professor Dr. Johannes Schmidt is known the world over; less well known is the fact he worked also with many other

oceanic fishes and invertebrates, and in other fields such as genetics, bacteriology, and botany, even including a paper "On the Aroma of Hops". Dr. A. Vedel Taning is now leader of the laboratory which continues Professor Schmidt's studies of ocean fishes, and with Dr. Anton Fr. Bruun and others has the tremendous task of sorting over the oceanographical collections of the various "Dana" expeditions.

There is a similar institution in Copenhagen called the Danish Biological Sta tion, directed by Dr. Blegvad, which works with various marine fish, especially the important plaice. One member of the staff is the Dr. Poulsen mentioned above. The fresh water branch of the station is situated at the mouth of lake Fure in historic Frederiksdal by Lyngby, formerly the home of the early microscopist, O. F. Muller. The resident biologist is Dr. C. V. Otterstrom of whose many duties the study of the young salmon and trout probably takes most time. He has evolved a technique for making rapid surveys of the course of a river, similar to those used in various parts of America and has a schedule for determining whether it be suitable for trout and if so how heavy the stocking should be of various sizes of fingerlings.

Finally, the University of Copenhagen has a biological station on the lake of Frederiksborg castle. Its director is the venerable Professor Dr. Wesenberg-Lund, well known for his studies of a variety of fresh water invertebrate phyla. At the moment he has under way a systematic compendium, something after the plan of our Ward and Whipple. His associate, Dr. Kaj Berg, has undertaken several experimental studies upon Daphnia.

RELATION OF SIZE AT RELEASE TO PROPORTIONATE RETURN OF HATCHERY-REARED COHO (SILVER) SALMON

By George B. Kelez, U. S. Bureau of Fisheries

DURING THE course of an investigation of the coho salmon populations of the Puget Sound region, certain marking experiments were undertaken to determine the degree to which individuals of this species returned to their native streams and the proportionate survival of the fingerlings when released at different sizes.

The first returns of adult fish from these experiments appeared during the spawning run of the past fall and winter, and, although returns are available for only one year's marking, they appear of sufficient interest to warrant a brief summary of the results.

In May, 1934, 26,150 hatchery-reared coho salmon, provided through the cooperation of the Washington State Department of Fisheries, were marked by excision of the adipose and dorasl fins, and released in Friday Creek, a tributary of the Samish River. These fish were hatched in February from eggs taken on the Samish River during the preceding fall; at the time of marking their average length was 47.4 mm. (1 7/8 in.) and their average weight was 1.55 grams (.05 oz.).

A second lot of fingerlings from the same brood was reared in the hatchery ponds until November, 1934, at which time 26,150 were marked by excision of the dorsal and left ventral fins and were also liberated in Friday Creek. At the time of marking the average length of this lot was 101.6 mm. (4 in.) and the average weight was 12.8 grams (.45 oz.).

During the spawning run of 1935-36, eight marked grilse, all from the November liberation, were recovered in the Samish River. These fish, approaching the end of their second year, were all males, and the average length (of six from which measurements were taken) was 41.3 cm. (16¼ in.). Inasmuch as they were small enough to pass through the bars of the rack, the return may have been larger than the recoveries indicate.

The normally maturing, three-year-old fish from these experiments returned during the spawning run of 1936-37. The hatchery rack, which blocks the entire Samish River (and is located below the mouth of Friday Creek), was partly opened by high water during the early part of the run and a number of marked and unmarked fish were able to ascend the river beyond the rack. A careful record was kept, however, of marked fish recovered at the rack, and a number of trips were made to the upper tributaries of the Samish River in search of marked fish. In regard to the return of these fish to their native stream, it appears significant that the majority of the marked fish which passed beyond the rack turned into Friday Creek, from which stream the water in which they were reared was diverted, and in which they were liberated after marking.

469 marked fish were recovered from the two experiments, of which 7 fish were from the first lot (small fish at time of liberation) and 462 were from the second lot (large fish at time of liberation). Of the 7 recoveries from the first experiment, 4 were taken at the rack, 2 in Friday Creek, and 1 in the upper Samish River. Of the 462 recoveries from the second experiment, 257 were recovered at or below the rack, 178 in Friday Creek, and 27 in the upper Samish River. On the basis of the total recoveries, the proportionate return of large to small fish was 66 to 1. For the recoveries at the rack only, the ratio was 64 to 1.

It is evident that the survival of the fingerlings which were reared for the additional six-month period was far greater than that of the smaller fish. Until these results have been confirmed by repetition, however, we must not overlook the fact that a considerable variation is possible in the indicated proportionate survival. Nevertheless, some speculation as to the effect of a longer rearing period would appear to be justified.

The returns from the first experiment consisted of 4 males and 3 females, those from the second one of 225 males and 237 females. Since the Samish fish strip at approximately 3,000 eggs per female, the fish returning from the second experiment alone would produce over 700,000 eggs. Approximately 300,000 of the resulting fingerlings, reared to the 4-inch size, would, if the survival remained the same as in the present experiment, produce on the next cycle more than 8,000,000 eggs, the average annual take of this hatchery.

If a continuing program of rearing large fingerlings were adopted, only 1/16 of the average egg take would be necessary to maintain the present run and the remainder of the eggs would be available for increasing the run in the native stream or for other purposes. If space were not available in the hatchery, the surplus adult fish could be allowed to spawn naturally. The possibilities of such a program would be limited only by the cost of rearing and the carrying capacity of the streams for resident young fish. Most of the rivers in this region are capable of carrying far more fish than they do at the present time, judging from the size of their coho populations of only ten or fifteen years ago.

Some rough data on the cost of production is available from these experiments. The food used throughout the rearing period for both small and large fish was the standard canned salmon prepared by the State Department of Fisheries from the carcasses of stripped spawners, with additions of cereal. For the small fish, on the basis of .41 grams average weight at the time of transfer to the rearing ponds, and 1.55 grams average weight at the time of marking, 585 pounds of food were necessary to produce 85.8 pounds of fish, or approximately 6.8 pounds of food per pound of fish. The cost of this feed was $0.0215 per pound, or $0.146 per pound of fish produced. For the large fish, 2,132 pounds of food were necessary to produce 815.7 pounds of fish, or approximately 2.61 pounds of food per pound of fish, the cost being $0.056 per pound of fish produced.

There are three factors which contributed largely to this difference in production cost. First, the amount of waste during feeding is far less for the larger fish than for the smaller ones. Second, since the fingerlings were held in open, outdoor ponds, a considerable amount of natural food became available during the summer, but not before the first lot of small fish were marked. Third, it is possible that the larger fish were more efficient in feed conversion than were the smaller ones. McCay and Tunison (1934) demonstrated that, for four species of trout held for 92 weeks, food-conversion was much more efficient during the 40th to 92nd weeks than during the 1st to 40th weeks. Lake trout showed the smallest change on the experimental diet fed, 3.06 grams of food producing 1 gram of fish during the early period of growth, and 2.35 grams of food producing 1 gram of fish during the late period. Brown trout showed the greatest difference, 5.14 grams of food per gram of fish for the early period, and 2.84 grams of food per gram of fish during the late period.

For the Samish cohos, the difference in food cost for the additional rearing of the large fingerlings was approximately $33.26, and the cost of producing 300,000

such fingerlings (including additional labor cost for preparation of food and feeding) would be less than $500.00.

The fact should be emphasized that this is a single experiment and that comparative figures for both proportionate returns of small and large fish and differences in cost of production must be obtained before we can determine the exact degree of benefit to be realized from the adoption of a prolonged rearing period. Additional experiments have been undertaken and are being continued at various hatcheries in this region for purposes of comparison, and to determine the optimum rearing period. Nevertheless, the results of this initial effort are such as to indicate a striking difference in comparative returns in the order of 65 from liberations of large fingerlings of this species to one from liberations of small fingerlings. Further results from similar experiments may well point the way to a definite rearing policy on a solid basis of cost and result.

SHOCKING THE FISH 1/

By John Carl, President, and J. R. Hodgson, Adviser
Cisco Sports Club, Cisco, California

TEN ACRES of water were lifted skyward recently up near the Donner Summit. Geysers rose a hundred feet above the surface of a once good fishing lake and the ground shook for hundreds of feet around. A new method of reclaiming trout waters for the king of game fish was being tried.

The Fish Planting Committee of the Cisco Sports Club had spent a good deal of time scheming, plotting, and planning last winter in search of the best way for ridding our lakes in the Donner Recreation Area of rough fish. Good fishing was rapidly going to the dogs. It was felt necessary, and the community as a whole vowed, to do something about it through their newly formed Sports Club.

1/ Dr. P. R. Needham, who transmitted this article, offers the following comment: "I suggested to Mr. Hodgson, that before they do any further dynamiting in lakes of the Donner Recreation Area, they give us a chance to conduct surveys both before and after treatment to determine the effect of the dynamiting on bottom foods, plankton, rooted plants, and other organisms. Doubtless most of the aquatic foods are destroyed in the process and quantitative food studies should certainly show up the nature and extent of the damage done. Indeed such studies might show the desirability of postponing replanting until lakes thus treated have had a chance to build back their aquatic food supplies. It would certainly be desirable and necessary to conduct preliminary surveys to select such lakes carefully before carrying on such drastic treatment as dynamiting. Population studies by means of seine, trap, or gill-net catches should give a good idea of the standing population and what would actually be accomplished by the process."

"Rough fish" in this vicinity consist mostly of a species of chub, along with a fair sprinkling of catfish. Introduced as bait a few years ago, chubs were beginning to crowd out game fish at an alarming rate. In a few lakes trout had completely disappeared, and of the 65 lakes in the Donner Trail Recreation Area, approximately one-third had acquired a thriving population of chub. No one knew just how long it took these finny fellows to crowd out the trout. We know very little yet on this subject but we do know how to get rid of the chub. In the ten acre lake chosen for the experiment a healthy population of chub was exchanged for one of lively trout fingerlings within a three-day period.

Lower Loch Leven Lake, easily accessible from U. S. Highway 40 and situated about one mile from Cisco by trail, was chosen. Trout fishing here had been excellent a few years back but of late years fewer and fewer trout could be taken. Those caught were growing so poor that they were unfit to eat. Last season one trout to nineteen chub was about the average catch and this year saw but one trout taken.

Now the 65 lakes and 140 miles of live trout stream are held to be one of our greatest recreational assets around the Donner Summit. While the Cisco Sports Club was comparatively young and was just getting on its feet there was a genuine feeling that something had to be done if we would save our fishing waters. Numerous letters were written, sportsmen all over the State were questioned, governmental agencies were contacted, and it all simmered down to getting rid of rough fish in one of three ways. Chub could be seined or netted out of the lakes; they could be poisoned by copper sulphate; or they could be dynamited.

After careful consideration the dynamiting method was chosen. Bluestoning, or treating with copper sulphate was found to be costly and as far as could be determined its effect was doubtful. Seining or netting was out of the question due to rock fissures in the lake bottom. No one knew how much dynamite it took to kill chubs but we determined this with a fair degree of accuracy.

As late summer approached various old abandoned wire fences and telephone lines in the vicinity began to disappear. Curious hikers came in from Lower Loch Leven Lake wanting to know why lines of wire were being stretched from tree to tree across the lake. Blocks cut from dead trees lying around the shore had been stapled to the wires, holding all lines high and dry above the water line. By August there was a line stretched every hundred feet about the lake. The Fish and Game Commission extended permit for the experiment. The U. S. Forest Service rendered all the cooperation possible. But the Cisco Sports Club did the job.

Publicity was avoided as a matter of safeguard against sightseers getting blown up along with the lake's population. Then word leaked out in some way and on the last Sunday of August, while Club members were hard at work tying bundles of dynamite and suspending them from the overhead lines on strings, a large crowd appeared. Two sound motion picture outfits arrived and set up to "shoot the works". Some fifty cameras were observed. An elderly lady, well past middle age, hiked up the steep mile of trail on crutches to see the dynamiting.

Bombs of from 10 to 20 sticks of 40 percent gelatine dynamite were layed midway between the lake surface and the bottom, the size of bomb depending upon lake depth. A few bombs were placed on the granite lake bottom on the chance of creating a greater shock. Number 18 detonating wire and water-proofed caps smeared with gear grease to further insure waterproofing were attached. An hour before sunset the warning gun was sounded.

At three points on the lake shore operators were ready with 50-shot detonating machines. Line number one, out over the deepest channel was to go first with its 16 large bombs set in 25 feet of water. The signal to shoot sounded. Several hundred people held a long breath. Current flowed out over more than half mile of detonating wire. Apparently nothing was to happen. Then at the far end of the lake a tremendous column of blue water shot into the air. Another rose close at hand. The whole lake seemed to be in the air then for a few moments as the rest of the detonating machines went into action. Water flew, the ground shook, and the sound cameras clicked on. Hurried snapshots by the score of this spectacular sight were taken by sightseers. The best shots will be sold to increase the Club's treasury balance.

Plenty of trouble was found after the blasting was over. It was soon discovered that about one-fourth of the bombs had not gone off. Club members made emergency repairs but without success. Chub floated on the surface of the lake by the thousands, but unless every one in the water had been killed there was grave danger of their reclaiming the water against all the trout that could be planted.

Every unexploded bomb was recapped and 6 more boxes of dynamite were set off the following day. Most of these bombs were placed on the granite lake bottom where they were now known to do the most good. During the previous night a severe wind had whipped the dead chub up onto the lake shore and we had a good chance to watch the effect of the second dynamiting. The second blasting did not produce a single dead chub, nor could any be seen alive in the lake. The first detonation, with bombs exploding every 100 feet had completely annihilated the unwanted rough fish. Over 20,000 chub were done away with, varying in size from 2 inches to 14 inches. Only four Loch Leven trout were found dead all of which were thin and in very poor condition.

Yes, the Cisco Sports Club learned how to get rid of rough fish. Other clubs, and erhaps some of the governmental agencies interested, will use our method in the future. It is simple. It is not too costly. We planted the Lower Loch Leven Lake with trout the day after the blasting. We feel that good fishing is no longer dependent upon merely planting game fish but that we are in the realm of lake and stream improvements whereby more young trout will grow up to add joy the greatest sport in the world.

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COMMENTS FROM OUR READERS

BASS OPERATIONS AT CAPE VINCENT, N. Y.

LATE IN MAY as usual 500 adult bass were secured from a local net fisherman and placed in our pond reservoir until June 1st when 450 were placed in three of our ponds. Two of these ponds had been filled and fertilized 12 days prior to June 1st. One pond was filled six days before June 1st and was not fertilized. At the same time our small pond was filled and heavily fertilized but no bass were placed in it. Prior to June I had agreed to give a farmer ten dollars rental for permission to put 50 adult bass in an old gravel pit covering about an acre and which stood full of water. This was not fertilized. On June 2nd 50 bass were placed in this pit.

On June 1st the water temperature in the two fertilized ponds here had a temperature of 70° F. The water in the reservoir where we were holding the bass had a temperature of 58° F. The temperature in the unfertilized pond was 62° F. The bass placed in the ponds having a temperature of 70° F. spawned immediately or within the first couple of days. Those placed in the pond having a temperature of 68° F. did not spawn until ten days later. Those placed in the gravel pit in which the water temperature was 74° F. spawned immediately. In all three ponds there is a good production of fry but there is ten days difference in the ages.

The fertilized ponds in which brood fish were placed produced a dreadful growth of algae and for ten days now three men have worked constantly removing this growth preparatory to using a seine to remove the adult bass, and the end is not yet. Many little fish gill in the stuff and a large growth of vegetation seem to choke out or prevent a large production of daphnia, etc. no matter what a fellow does.

Filling the small pond later and fertilizing it heavily with manure so discolored it as to check the development of vegetation but produced a good crop of daphnia, etc. About June 17 we removed about 25,000 fry from the gravel pit and put them in this small pond in which there was an abundance of animal life. Today these fish are twice as large as the fish in our other ponds and are coming fine. There isn't a pinheaded fish in the pond. In the other ponds in which there is an abundance of vegetation and a scarcity of food we have many little black pinheaded cusses that will only make food for those that have already become cannibals.

If you fill and fertilize ponds heavily in time to get a big production of small aquatic life just when baby bass need it you cannot put brood bass in it and get a crop of fry. If you fill the ponds and fertilize them early so as to have the ponds fit for brood bass when spawning time comes you get such a mass of vegetation as to choke out or kill a big crop of daphnia when needed. The two just don't go together, except in new ponds. It will not work in old ponds. Mr. Langlois gets away with it by using enough crayfish in his ponds to keep the ponds muddy and thereby prevent the

growth of vegetation. I got a supply of these crawfish from him last fall and tried to hold them over the winter in our pond reservoir but apparently they all died.

If another spring I can find the money to rent a few gravel pits, or farmers' ice ponds, to be used temporarily as brood bass ponds every one of our ponds here will be used as nursery ponds if I have my way. They will be filled late and made copper colored with manure so as to have them filled with daphnia when the small bass are brought in from the gravel pits.

J. P. Snyder
Superintendent

FISH CULTURE AND FISH PSYCHOLOGY

(Editor's Note: This is the third anonymous letter received in enveloped postmarked "Fremont, Ohio". Our rule against publishing such letters is herewith broken once more without apology. To the writer may we say, "Come out of the bushes, friend. Drop the false whiskers and many aliases and in your own right receive our thanks for providing several good laughs thus lightening in a measure the sober business of fish culture.")

The Progressive Fish Culturist
Washington, D. C.

Gentlemen:

The psychologists tell us that the more often our nervous system reacts to a certain stimulus in a given way the more automatic and unconscious our reaction becomes. Given the usual stimulus we eventually react in the usual way even without thinking. In other words, we form habits.

We fish culturists know that fish, too, form habits, but do we take advantage of this in our work? We do not.

Take for instance the raising of fish in a 20 foot circular pond. The fish follow the margin, on other words, they go round and round. And the more they go round and round in this 20 foot circle the more they get the habit.

Now plant these fish from the 20 foot pond into a 10 foot stream and what happens? They keep bumping their noses against the shore and fungus sets in. Plant them in a lake and what happens? They eat all the food in the 20 foot circle and starve to death even if the rest of the lake contains lots of food. And if a predator wants to catch the fish all he needs to do is lie in the 20 foot circle with his mouth open and close it (the mouth) when the fish has reached the right spot in its circuit.

This shows the striking need for more psychology in our fish work.

Yours truly,

A Fish Psychoanalyst.

GROWTH OF WILD AND DOMESTICATED TROUT

IT HAS LONG been known that brook trout hatched from the eggs of domesticated brood fish grow much more rapidly than those hatched from eggs from wild trout. During the spawning season of 1936 eggs from wild females were fertilized by milt from choice domestic males. Early in the feeding period it was thought that the young from this cross were making equal growth with the straight brood fish offspring. Later it was found that they were dropping behind. The comparative weight on July 20 follows:

100 fish from brood stock weighed.....12 oz.

100 fish from the cross weighed..... 8 oz.

Thus it may be seen that the hybrids grew only 66.7 o/o as fast as the domesticated stock. While these fish were not handled as a controlled experiment, the conditions under which the two lots were held were practically identical.

In this connection it will be of interest to note some weights secured on August 22, 1934.

500 fish from brood stock weighed.....29 oz.

500 fish from newly captured wild fish weighed.....17 oz.

The wild fish grew only 58.6 o/o as fast as the domesticated stock.

While these various lots of fish were not handled in a way to furnish reliable data, the indications are that there was a little advantage in using the domesticated males.

The much greater weight of the fish weighed July 20, 1937 over those weighed in 1934 is due to better environment of the fish this season but does not affect the comparison of the two strains during a given season.

A. H. Dinsmore,
Superintendent, Berlin, N. H.

GROUND LIMESTONE IN POND BOTTOMS

LIMESTONE, ground very fine, was placed in the ponds at Fairport, Iowa in 1935 during the months of November and December. The stone cost approximately thirty-five cents a ton and was hauled by the station truck from the source of supply. A thin coat of this was scattered over the ponds and dragged into the bottoms with a harrow.

In the spring of 1936 we noted a heavier growth of vegetation in the pond bottoms than in previous years. After the water was turned into them this growth became more abundant, and as the season progressed, it became rank. When cleaning time came in September, the work of getting the growth out of the ponds in order to drain them properly turned out to be a task much larger than in previous years.

The results from this great amount of vegetation showed in the size of the fish produced. Last fall, as a result, we had thousands of very large bass. The bream, also, were larger, as were the crappie. In previous years, with less vegetation in the ponds, there were more fish but they were smaller. The average size of the bass last year was four to four and one-half inches and several hundred were eight, ten, and twelve inches in length.

For example, pond D-10 (area 3.5 acres) produced 34,687 fingerlings 3 to 3.5 inches long in the fall of 1935. In the following year, after the application of lime, this pond produced 17,769 fingerlings from 4.5 to 6 inches long and 275 fingerlings from 8 to 12 inches in length. In both years the pond was stocked with advanced fry at the rate of 15,000 per acre, or a total of 52,500 fish. In both 1935 and 1936 the pond was stocked with blackhead and bluntnose minnows for forage, a total of 1,750 minnows being placed in the pond each year. At the end of the season, 3,700 minnows were removed from the pond in 1935 while in 1936 no minnows were found at the time the pond was drained.

If we want larger fish for distribution, a great deal of vegetation and a consistant feed program of live meat is imperative, plus what we can raise in the ponds through protection by the heavy vegetation, not alone of daphnia, but other aquatic life and forage minnows.

Personally, we prefer less vegetation, plenty of live meat, culture daphnia, and forage minnows and get more fish of a fair size of young, than a few of a large size to be caught immediately by people who just want to tell a big story.

Leslie H. Bennett,
Foreman in Charge,
Fairport, Iowa.

DEVICE FOR TRANSPORTING GREEN EGGS

Mr. John H. Asbell of the Bureau of Fisheries Station in Edenton, North Carolina, has developed a piece of equipment which is reported to have been very satisfactory in transporting green shad eggs during the past season.

It consists simply of two wire hoops approximately 11 inches in diameter covered with ordinary scrim in double thickness on the sides and bottom. The same material is used to form an inner pocket slightly smaller than the outer container. The scrim also forms a loose cover or top which can be closed by tying in the center. The whole is assembled by attaching the hoops to vertical strips of 1" x ¾" wood, seven of them being used. In effect, this forms a bucket-shaped scrim cylinder. In transporting, the eggs are placed inside, the top is tied, and the whole is transported in a spawning bucket holding about five gallons of water.

With the use of this apparatus, the shad egg collecting field of the Edenton Station was extended greatly in comparison with previous years.

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